



# The University of Vermont

## CHEM 202: Advanced Chemistry Laboratory

### Chem 202 Syllabus - Fall 2015

#### Course Description:

**What the UVM Catalogue says about CHEM 202 - Advanced Chemistry Laboratory:** "Laboratory problems requiring modern analytical, physical, and inorganic synthetic techniques."

CHEM 202 is the second of the two course sequence starting with CHEM 201.

#### Learning Goals:

- To apply knowledge of chemical and physical principles to the solution of chemical problems
- To understand the interplay of observational data, hypotheses, and hypothesis-driven experimentation through application of the scientific method
- To become proficient in chemical laboratory techniques and apply these techniques to practical and current problems in research
- To be able to read and critically evaluate the chemical and scientific literature
- To learn to present scientific data clearly and effectively through both written and verbal communication

The prerequisite for CHEM 202: Completion of **CHEM 201**

#### Lecture:

**Monday & Friday, 2:20 - 3:10 pm, Old Mill Annex (OMANEX) A304**

Any special classes on Wednesday will start at 2:30 pm in Cook A229

The foci of Advanced Chem Lab are the laboratory experiments and the lab write-ups and presentation. The purpose of the class time is to provide lectures about the chemistry and instrumentation that will be in each laboratory. As such, we won't need to meet every week.

See calendar of classes for which days class will meet.

#### Laboratory:

**Wednesday 1:10 - 5:10 pm, Cook A105 & A215 (NMR room)**

#### Text:

**No text covers the diverse laboratories in the course.** Readings will be provided as (i) published articles in the scientific literature that can be accessed via a UVM IP via SciFinder or PubMed, (ii) chapters from books and (iii) books on reserve in the chemistry library. Students will also have to search the literature for additional articles relevant to particular laboratories.

#### Course Instructor:

Dwight E. Matthews 656-8114 Cook A121

#### Graduate Teaching Assistants:

Daniel DePuccio Cook A135 – Expts 1 & 2

Joseph Wright Cook A123 – Expt 3

#### Office hours:

Scheduled per student need

#### UVM Policy on Absences:

Religious Holidays: Students have the right to practice the religion of their choice. Students should submit in writing by the end of the 2nd full week of classes their documented religious holiday schedule for the semester if there are any conflicts with the class or laboratory schedule.

*Inter-collegiate Athletics:* Members of UVM varsity and junior varsity teams are responsible for documenting in writing any conflicts between their planned athletic schedule and the class (& laboratory) schedule by the end of the 2nd full week of classes.

#### UVM Policy on Academic Integrity:

Offenses against the Code of Academic Integrity are deemed serious and insult the integrity of the entire academic community. Any suspected violations of the code are taken very seriously and will be forwarded to the Center for Student Ethics & Standards

for further investigation. [Details](#)

## How the course grade is determined:

	Points	
Written lab reports (3 x50 points each)	150	54.5%
Oral report (1 x50)	50	18.2%
Glassblowing exercise	25	9.1%
Lab performance and lab notebook	25	9.1%
Participation during oral presentations	<u>25</u>	<u>9.1%</u>
<b>Total:</b>	<b>275</b>	<b>100%</b>

**Failure to submit a lab report:** any missing lab report will be assigned a grade of **-50** points.

**Update the literature used for the various labs.** Bring me (DEM) a good article from the literature or chapter from a book reviewing or discussing a key aspect of any of the labs *that is newer and better than the existing references already cited for the lab*, and I will give you 5 points up to a maximum of 30 points.

## More Information About Chem 202:

### Lab safety:

- You will continue the same laboratory safety practices as in CHEM 201.
- You are responsible for knowing what chemicals and what procedures are being used *in advance* of each laboratory. You will be expected to come to the laboratory already equipped with the necessary safety information concerning chemicals to be used in that laboratory.
- You can get the necessary safety information from [the Chem. Dept Lab Safety page](#) including:
  - [Material Safety Data \(MSDS\) info.](#)

### Lab notebooks:

**Yes you need to keep a laboratory notebook.** The notebook is worth up to 9% of your grade. The usual is expected with regard to the notebook:

- Mark your notebooks clearly with your name and address.
- Be sure you have your notebook with you when you come to lab. *You will have points taken off and you may be dismissed from the lab if you do not have your notebook.*
- Each day's entry will be preceded by an entry of the **date** of work.
- All entries will be in permanent ink.
- All entries will be readily readable! *Points will be deducted for bad hand-writing and ambiguous numbers.*
- All data that needs to be written down (e.g. a weight from a balance) will be entered at the time you collect it, not on scraps of paper to be entered later. *You will have points taken off if you do not record data properly in your notebook during the lab period.*
- It's helpful if you bring a "thumb-drive" or USB memory stick to lab to download data into a format that can be transferred to Excel for further processing and plotting for lab reports.
- Although much of the data you collect will come from a computer controlling an instrument, you still need to record all of the operating parameters of an instrument at the time you are using it.
- You should organize for every experiment in advance, prior to starting it, and try to arrange space in your notebook for that day's experiment accordingly.

### Lab reports:

#### [Get info](#)

### Oral presentation:

Communication skills are critical to success in a career in science. Everyone presents their work during their careers. Here is a perfect opportunity for you to develop your presentation skills in a less threatening environment.

- We will be using a *Journal Club* format for presentations
  - You will search the scientific literature for an article(s) to present.
  - Start your search by reviewing reviews in the chemical literature to find an appropriate topic.
  - Use that review to hone in on a recent article(s) for your presentation.
- Once you have your topic from your review article and subsequent article(s), see me (DEM) to get approval for your topic.
- Based upon the chemistry foci of CHEM 201-202, relevant areas of chemistry that can be chosen are inorganic chemistry, physical chemistry, physical organic (mechanistic) chemistry, & analytical focusing upon instrumentation.
- You will have ~30 min to present and 10 min for the audience (your class & instructors) to ask questions.
- An overhead computer-projection device projector that connects to a PC and an overhead display camera will be available for your talk, or you may bring your own laptop to attach.

- Once you have your topic approved, send me an e-mail (**DEM**) providing the full literature citation of your review article(s) and intended article(s) you want to discuss in your presentation. At this point, you can then select a presentation date that will be approved by me (DEM).

### General lab format:

- At the start of each lab, your TA will get together with you to discuss the experiment to be done. This is your best chance to ask questions. Preliminary reading assignments, the general plan for the experiment, etc. will have been given to you at least a week in advance of the experiment.
- Key to success in the course is a positive mental attitude when you arrive to start a lab. We will have done the best we can in preparing an experiment, but Murphy's law will sometimes strike, causing delays or slowing completion of experiments. Should extraordinary difficulties occur, your TA will work with you to extend working hours or to complete the experiment at another time.
- We have planned each laboratory so that all necessary data can be obtained within the scheduled laboratory time. Although you should plan on being present for the full-scheduled time, we hope to complete the experimental part of each lab in much less than the 6 hours of allotted time.

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## Brief Synopsis of the Laboratory Experiments:

### Lab #1: Vacuum Chemistry

**2 week lab.** You will learn how to manipulate, move, sample and measure gases using a vacuum line. Two gases,  $\text{BF}_3$  and  $(\text{CH}_3)_3\text{N}$  will be combined to form a solid-state product. In the 2nd week, you will confirm and characterize the product by melting point, FT-IR, and  $^2\text{H}$ ,  $^{13}\text{C}$ ,  $^{19}\text{F}$ ,  $^{11}\text{B}$  by NMR using the *Bruker 500 MHz Avance III*.

### Lab #2: Kinetics Measurement by NMR

**1 week lab.** You will use the *Agilent (Varian) 500 MHz NMR*, taking advantage of the instrument's resolution and sensitivity to acquire  $^1\text{H}$  data for the keto-enol kinetic determination of the tautomerization of diketones ethyl acetoacetate and acetylacetone in deuterated methanol. This experiment is an extension of the CHEM 201 lab where the equilibrium constants were determined. Here you seek to measure the loss of hydrogen and increase in deuterium into both the diketo and enol species over time. From these data you can determine the relative rates of the forward/backward rates of the equilibrium.

### Lab #3: Synthesis of Nickel-Group Dithiolenes

**2 week lab.** You will complex maleonitriledithiolate (mnt) to nickel to form the  $[\text{NEt}_4]_x[\text{Ni}(\text{mnt})_2]$  complexes (where  $x = 1$  or  $2$  and  $\text{NEt}_4^+$  is tetraethylammonium cation). On the 2nd week you will characterize the complexes by IR, UV-Vis and by solution conductivity.

### (#4) Glassblowing exercise

**2 half days.** You will work in pairs in the glass shop in two tutorial sessions with our Department glassblower, Angela Gatsy. You will arrange your time in the glass shop directly with Ms. Gatsy, completing the requirements of this exercise *before the Thanksgiving break*.



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